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Improved Equipment for Weighing and Packing Turkeys

Agricultural Research Service
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ACKNOWLEDGMENTS

The experimental equipment described in this report was tested in a California turkey packing plant. Appreciation is expressed to plant management for cooperation in making their facilities available for study and to the equipment concerns who contributed time and equipment for the research.

This work was conducted under the supervision of John A. Hamann, Investigations Leader, Handling and Facilities Research Branch, Transportation and Facilities Research Division, Agricultural Research Service, in cooperation with the Department of Food Science and Technology, University of California, Davis, Calif.

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Transportation and Facilities Research Division
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In Cooperation With

THE UNIVERSITY OF CALIFORNIA
Agricultural Experiment Station

Improved Equipment for Weighing and Packing Turkeys

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SUMMARY

Whole, ready-to-cook turkeys are manually placed in plastic film bags before they are packed in containers. The operations in this processing area consist of inserting giblets in the crop cavity, weighing the bird and marking its weight on the plastic bag, placing it in the bag, and closing the bag on a vacuum machine.

To increase the efficiency of these operations, an experimental weighing and bagging line was designed and tested. The line included a gravity chute to aid in placing the turkeys in plastic bags; a rack to hold plastic bags in a convenient position for the workers; an in-line scale with magnified read-out dial, and a belt conveyor to move the bagged turkey to the vacuum unit. A crew was trained to use the equipment and tests were made in a commercial plant.

With this experimental equipment, worker productivity in weighing and bagging turkeys can be increased 7 percent on a one-scale line and 15 percent on a two-scale packing line.

The most productive combination of operations on a one-scale manual line requires six workers. The production rate is 670 birds per hour. With the experimental equipment, a production rate of 710 birds per hour is achieved with six workers.

On a two-scale manual line, the most efficient methods require 13 workers for a production rate of 1,430 birds per hour. The same production rate is achieved with 11 workers with the experimental equipment.

INTRODUCTION

The work performed at the end of the processing line for whole, ready-to-cook turkeys--weighing the turkeys and placing them in plastic bags--often becomes a bottleneck to the overall processing operation. These tasks are time consuming and tiring, and little mechanized equipment is used.

The most difficult part of the job is placing the turkeys in plastic bags. Equipment manufacturers have not shown much interest in developing equipment to perform this task, probably because of the relatively low return for costly developmental research compared to possibilities in other operations on the processing line. Nor has management of turkey processing plants attempted to improve methods used in performing this work, probably because it is considered only a small part of the overall, rather complex, processing operation.

This study was made to develop improved work methods or equipment for weighing and packing turkeys and to increase the overall efficiency of turkey-processing lines.

[1] Mr. Walters has resigned from the U.S. Department of Agriculture.

PROCEDURE

The weighing and packing operation was observed in 15 turkey processing plants in the West and Midwest to determine the work methods and equipment combinations commonly used in industry. The packing-crew jobs in selected commercial plants were analyzed by time study methods to determine the average labor requirements. From these data, production rate ranges and optimum equipment arrangements were determined as a basis for comparison with any improvements in equipment and work methods that could be developed.

Manual placement of turkeys in plastic bags was the method studied. Several plant operators said they had tried using shaping templates but had found them to be less effective than manually placing turkeys in bags. The templates did not provide guides for keeping the carcass upright as it was moved onto the template, nor was there any built-in feature that aided in the proper positioning of the bag as the bird was inserted. It was often necessary to shift the carcass in the bag in order to center the label on the turkey breast before closing the bag. The carcass had to be manually lifted for placement in the template and the method required two people to bag each turkey. Because a number of plants had tried and discontinued the template method, it was not evaluated.

Based on a careful study of work methods being employed, a gravity chute to aid in bagging turkeys was designed and tested in the laboratory. The chute was modified, and an experimental weighing and bagging line was developed and tested under commercial operating conditions.

The time values developed in this study are for ready-to-cook, young hen turkeys. These time values were determined by stopwatch readings, with the exception of parts of two studies which were made with the aid of a constant-speed motion-picture camera. Production rates established in this report were computed by determining actual or base time required by an average worker to perform an operation or series of operations on 100 turkeys.

The time values were adjusted to allow for fatigue before establishing the number of times the operation could be repeated per hour throughout an entire day. The adjusted figure does not include personal allowance, because a rest period is granted after every 2 1/2 hours, and it is not a common practice for a worker to leave his work station during a work period. Most of the operations on the packing line involved physical effort, such as moving and positioning turkey carcasses which weighed an average of 12 pounds. Other operations, such as weighing turkeys and marking the weight on bags, involved mental effort and were adjudged as having a comparable fatigue value. A fatigue allowance of 10 percent was therefore used in adjusting the base time for each operation.

A better-than-average worker can exceed his average productivity by 25 percent, and the average worker can be expected to increase his output by 15 to 20 percent for short periods of time without decreasing the quality of workmanship. Many such cases were noted during the course of this work.

OBSERVED METHODS OF WEIGHING AND BAGGING TURKEYS

DESCRIPTION OF OPERATIONS

Most processing plants pack turkeys under a number of brand names in preprinted plastic bags of various sizes. The weight and grade of the turkey determine which brand name is used, and the weight of the turkey determines the size of the bag.

The work elements involved in weighing and bagging turkeys are distributed among a number of employees, depending upon the equipment layout and the production speeds of the plant. Arrangements vary considerably from plant to plant.

Of the packing lines studied, two basic layouts were used most frequently: (1) the one-scale line; and (2) the two-scale line, with two scales mounted back to back. Figure 1

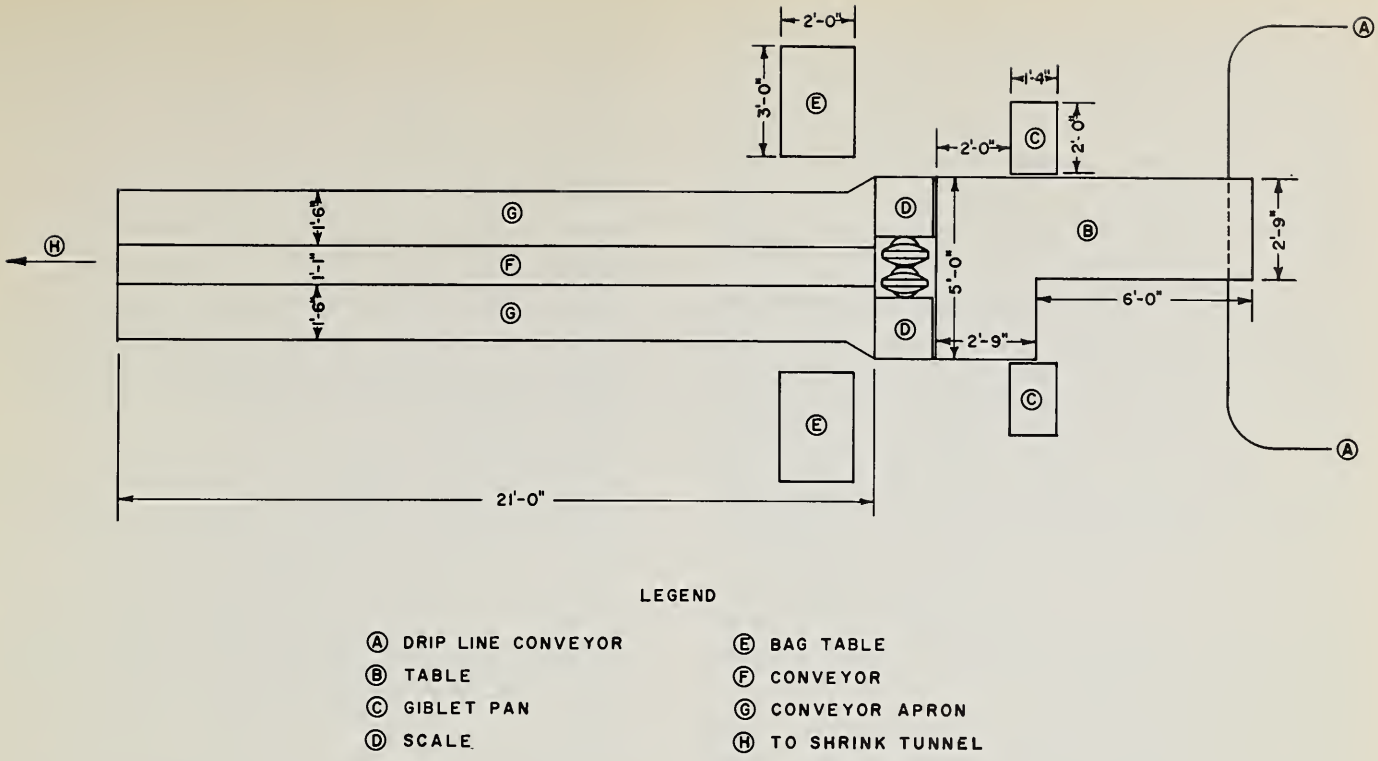

Figure 1.--Recommended equipment layout for a two-scale manual turkey bagging line.

illustrates a good arrangement for a two-scale weighing and bagging line.

Chilled turkeys are delivered on an overhead conveyor (the drip line from the chill tank) to the grading, weighing, and packing area. A worker removes the turkeys from the conveyor and places them on the table in front of the grader, or the turkeys may be automatically dropped from the conveyor. Drip-line shackles that drop the turkeys automatically have recently become available, and it is expected that this type of shackle will come into general use in the future.

When two or more scales are used, the grader quite often routes the turkeys by grade to the workers who insert giblets (heart, liver, and gizzard in a parchment pouch) into the crop cavity of the birds. This operation is referred to as stuffing giblets. In some plants, obvious undergrades are segregated immediately following evisceration. The undergrades are then packaged at one time at the end of a lot or the end of the day. This practice eliminates the confusion and resultant slowdowns or line stoppages that occur when a high percentage of undergrade birds are packed at the same time as top grades.

The grader and the giblet stuffers work at the same table in some plants, and in others, a belt conveyor of table height leads from the grading table to the table where giblets are inserted. Stuffing giblets also is sometimes done before the turkeys are graded.

In some plants, the giblet supply is in small chill tanks or pans near the table. Figure 1 shows a position for such pans that reduces the reach distance of the giblet stuffer to a minimum. The pan should be no more than 8 inches deep, and it should be placed so that its top is flush with the work surface. A good work surface height for the entire line is 34 inches.

Additional duties are often assigned to the giblet stuffer. One such duty is to push the turkey onto the scale platform as the scale operator slides the preceding turkey from the scale. At certain production rates, the giblet stuffers obtain their own supplies of giblets from a central supply tank and remove any loose ice from around them. This, of course, reduces the rate at which the worker stuffs giblets, but eliminates the need for someone else to handle the supply job.

After the giblets are stuffed in the turkey, the worker pushes the turkey along the table toward the scale (or he may slide the turkey onto the scale).

The scale operator reads the weight of the turkey and calls the weight to another worker, who selects a bag of the proper brand and size and writes the weight on the bag. In some plants the scale operator also selects and marks bags. In addition, most scale operators either slide the turkey onto the scale or off the scale, or both.

The weighing equipment and the manner of installation are factors that influence production rates. Scales that have fixed magnifying glasses over the dial window are easier to read than others. Scales of the quick-settling type should be used, and they should be mounted independently of all other equipment so that vibrations do not affect the reading.

The worker who selects and marks bags drapes the bag over the turkey and pushes the turkey onto the conveyor leading to the bagging station (fig. 2).

Since many plants are selecting from as many as five different bags, the supply should be in a convenient location. The bag table should not be fastened to the floor and should be readily moved. The table should have at least one shelf in addition to the top. It is important that the most frequently used bag is in the most convenient position. Obviously, when the number of bags used is held to a minimum, the production rate is higher because it takes less time for the worker to decide which bag to use and to position his hand to write the weight on the bag. In plants using two scales, a common practice is to assign certain sizes and grades to each scale and to have the carcasses routed accordingly by the grader.

It is good practice to position the bag marker so that he faces the scale operator. Under conditions of high noise level, the ability to receive information audibly is increased by observing the facial movements of the person who is talking.[2] In some plants where the scale operator and bag marker

[2] Harris, C. M. Handbook of noise control. McGraw Hill Book Co., New York. 500 pp., illus. 1957. See pp. 9-11.

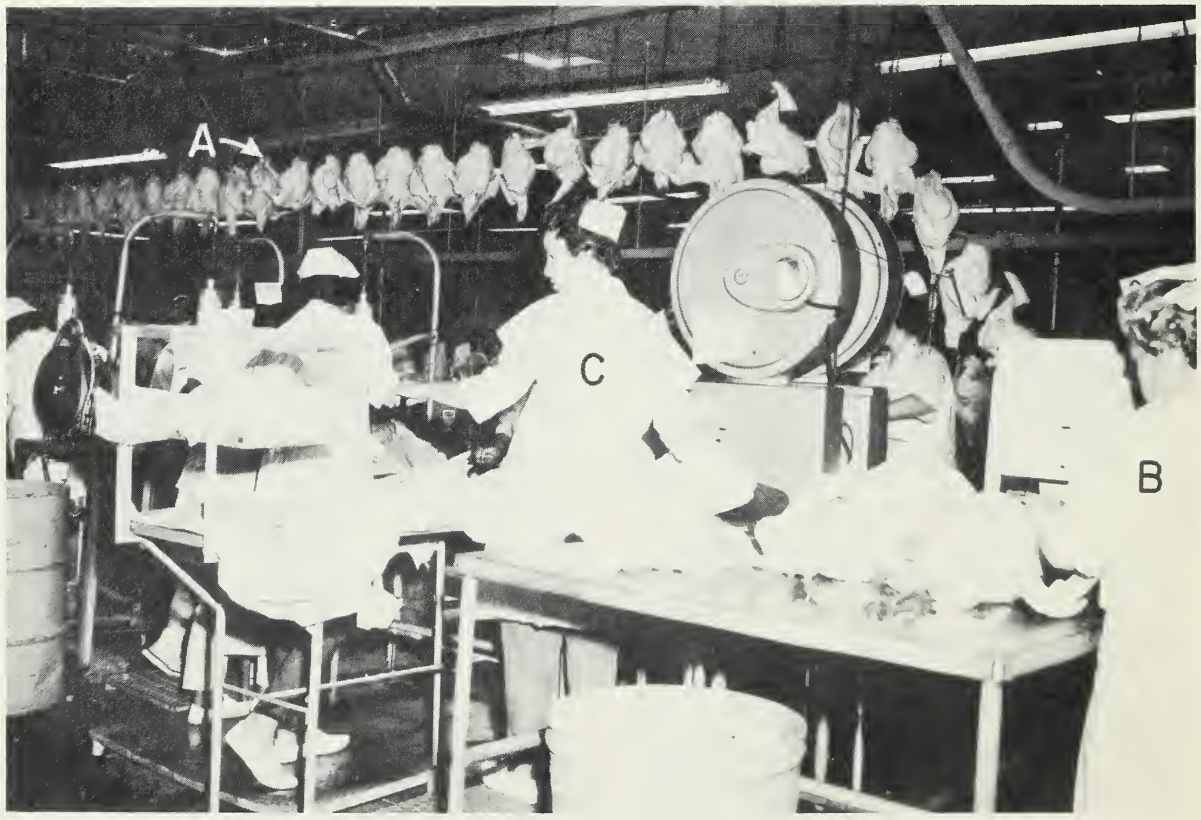

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Figure 2.--A, Ready-to-cook turkeys on conveyor to weighing and bagging area; B, worker inserting giblets into crop cavity; and C, scale operator selecting the proper bag after reading the carcass weight.

are stationed several feet apart, or where the noise level is extremely high, a headphone and throat microphone set is used.

When the scale operator also selects and marks bags, the most frequently used bag should be placed on a shelf directly over the scale platform. The shelf should be mounted 16 inches above the platform and should be approximately 16 inches deep and equal to the length of the scale platform.

The bagging station is an apron at one or both sides of the conveyor. The 18-inch-wide apron shown in figure 1 is adequate work station space for a bagging line handling both hens and toms. Smaller aprons are too small for large tom turkeys and wider ones increase reach distances.

The worker takes a turkey from the conveyor and gradually works it into the bag (fig. 3). No special tools or aids are used. The worker puts the turkey back on the conveyor for movement to the next work station, where air is evacuated from the bag and the bag is closed.

Although the effect of closely fitting bags on the time requirements for bagging was not studied, it was noted that considerable difference existed between plants as to the size of the bags used for a specified turkey size (fig. 4). A closely fitting bag reduces packing material cost and provides for good product appearance. The worker needs more time, however, to place turkeys in closely fitting bags. Quite often the bagging operators are not working at full capacity and can manage an occasional closely fitting bag without affecting overall production rates. The cost of larger bags, which are easily placed on turkeys, must be balanced against the cost of the additional labor required for smaller, closely fitting bags.

At the bag-closing station, the worker checks to see that the turkey breast is properly alined with the bag label and that the wings and hocks are properly tucked or positioned, and adjusts the position of the bird if necessary. The worker then slips the open end of the bag over the nozzle of a vacuum machine,

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Figure 3.--Worker bagging a turkey manually.

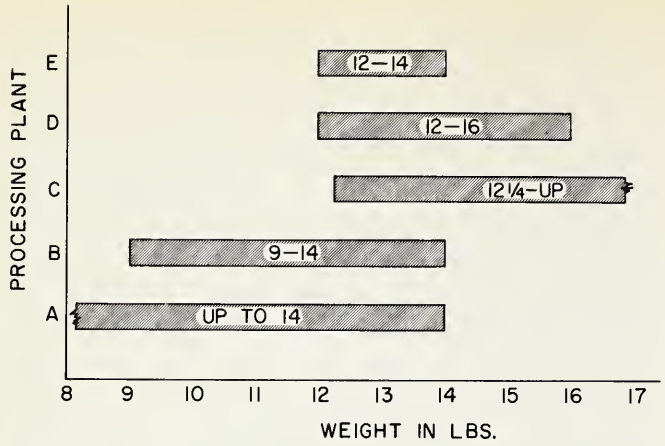

Figure 4.--Weight range of young hen turkeys packed into 13-inch bags by five different processing plants.

starts the machine, and rotates the bag to obtain an airtight twist closure (fig. 5). The machine applies a metal clip at the twist, and the worker trims the end of the bag. The worker then places the turkey on a conveyor that leads to a heat-shrink tunnel where the bag is shrunk so that it neatly conforms to the shape of the turkey.

LABOR REQUIREMENTS AND PRODUCTION RATES

The labor requirements and production rates for the various methods of performing the operations on the weighing and bagging line, from stuffing giblets through closing bags, are shown in table 1.

Labor requirements for loading and unloading the drip line and for grading were not determined because they were not needed to make comparisons between the experimental and existing bagging equipment. However, to determine the rates at which carcasses could be delivered to and removed from the bagging and weighing operations, a few studies were made of the supply operations. Shackle-loading studies indicated that approximately 900 birds per man-hour could be hung on the drip line from the chill tank. Factors affecting the supply rate include shackle type, distance between shackles and the chill tank, shackle spacing, rigidity of the shackles, and the procedure for supplying chill tanks.

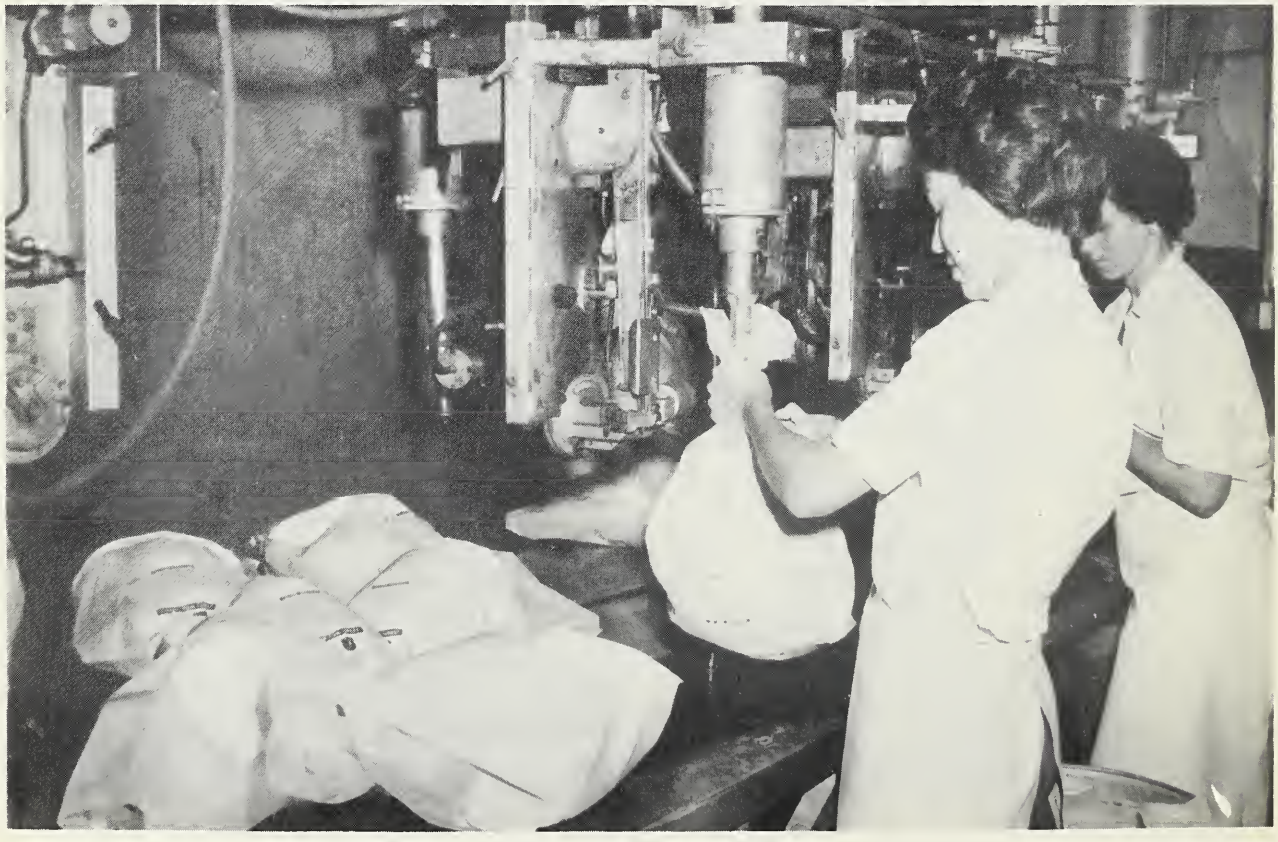

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Figure 5.--A worker evacuating air from a bag on a vacuum machine.

TABLE 1.--Labor required and production rates to perform various operations in weighing and manually bagging 100 hen turkeys

Operation	Labor required	Production rate
	Man-hrs.	Birds/hr.
Stuffing giblets and other duties:		
Stuff giblets into turkey	0.06	1,670
Stuff giblets into turkey and slide turkey onto scale, in coordination with weighing operation	.12	830
Stuff giblets into turkey and replenish supply of giblets from chill tank	.07	1,430
Weighing turkeys and other duties:		
Read scale, call out weight, and slide turkey off scale	.11	910
Read scale, call weight to bag market, push turkey off scale and at same time slide next turkey onto scale	.14	710
Read scale, select bag, mark weight on bag, and slide turkey and bag off scale	.15	670
Selecting bags and marking weight:		
Select bag, write weight on bag, drape bag over turkey, and push turkey and bag onto conveyor	.13	770
Placing turkeys in bags:		
Slide turkey and bag from conveyor, pull bag on turkey, and put turkey back on conveyor	.25	400
Close bags on vacuum machine:		
Take bagged turkey from conveyor, check alinement of turkey in bag and adjust position if necessary, place bag opening over machine nozzle and twist bag, place seal or clip on bag, cut off excess bag end, and place turkey back on conveyor	.29	350

In some plants only one person was required to unload the line as it approached the weighing and bagging area, even though production speeds were in excess of 1,800 birds per hour. Work station design exerts a considerable influence on the production rate for this job. On slower production lines, the worker who unloaded the line quite often was assigned additional duties, such as checking the hock, wing, and neck flap positions.

THE MOST PRODUCTIVE COMBINATIONS OF EXISTING METHODS

The most productive combinations of operations were developed for the one-scale and two-scale weighing and bagging systems, using the existing methods and equipment.

One-Scale System

The most productive crew arrangement for the one-scale system employs six workers and operates at 670 birds per hour (table 2). The total labor required is 0.90 man-hour per 100 birds. In this arrangement, the giblet stuffer slides turkeys onto the scale and the scale operator weighs the turkey and marks the weight on the bag. The elapsed time for weighing and bagging 100 ready-to-cook hen turkeys is 0.15 hour. This is the time required for the scale operator to weigh turkeys and mark the weight on bags. The other operations require slightly less time.

Two-Scale System

Of the various two-scale systems studied, two crew arrangements were found to be similar in productivity. Each requires 13

TABLE 2.--Labor required to weigh and manually bag 100 hen turkeys on a one-scale line, using most efficient present methods

[Elapsed time--0.15 hour; production rate--670 turkeys per hour]

Operation	Crew size	Labor requirements		
		Productive	Unproductive[1]	Total
	Number	Man-hours	Man-hours	Man-hours
Stuff giblets into turkey and slide turkey onto scale	1	0.12	0.03	0.15
Read scale, select bag, mark weight on bag, and slide turkey and bag off scale	1	.15	0	.15
Place turkey in bag	2	.25	.05	.30
Close bag on vacuum machine and trim end of bag	2	.29	.01	.30
Total	6	.81	.09	.90

[1] Job-regulated wait-time.

workers and operates at 1,430 birds per hour. Labor requirements are 0.91 man-hour per 100 birds (tables 3 and 4). In these systems, one of the operators usually works at 100 percent capacity or slightly over his capacity, while others work at a lower level of productivity or are required to wait for others in the operation. The difference is shown as unproductive labor (job-regulated wait-time) in the tables. These figures are based on average workers and existing work station layouts. It must be recognized that not all workers are average, and that good management requires crew rearrangement to utilize to a maximum the abilities and skills of each worker in the crew.

There are several factors which can outweigh the consideration of labor costs for bagging turkeys when selecting the proper crew arrangement, such as the rate at which carcasses can be frozen, the likelihood of incurring excessive overtime, and others. These factors must be judged according to the influencing conditions in each plant.

TABLE 3.--Labor required to weigh and manually bag 100 hen turkeys on a two-scale line, using System A

[Elapsed time--0.07 hour; production rate--1,430 birds per hour]

Operation	Crew size	Labor requirements		
		Productive	Unproductive[1]	Total
	Number	Man-hours	Man-hours	Man-hours
Stuff giblets into turkey and slide turkey onto scale	2	0.12	0.02	0.14
Read scale, call out weight, and slide turkey off scale	1	.06	.01	.07
Select bag, mark weight, and push turkey and bag onto conveyor	1	.07	0	.07
Read scale, select bag, mark weight on bag, and slide turkey and bag off scale	1	.07	0	.07
Place turkey in bag	4	.25	.03	.28
Close bag on vacuum machine and trim end of bag	4	[2] .28	0	.28
Total	13	.85	.06	.91

[1]Job-regulated wait-time.
[2]The labor requirement for this operation was 0.29 man-hour per 100 birds (see table 1). In this combination, the workers are required to work at 2 percent above normal pace.

TABLE 4.--Labor required to weigh and bag manually 100 hen turkeys on a two-scale line, using System B

[Elapsed time--0.07 hour; production rate--1,430 birds per hour]

Operation	Crew size	Labor requirements		
		Productive	Unproductive[1]	Total
	Number	Man-hours	Man-hours	Man-hours
Stuff giblets into turkey	1	0.06	0.01	0.07
Read scale, call weight to bag marker, push turkey off scale and at same time slide next turkey onto scale	2	.14	0	.14
Select bag, mark weight, and push turkey and bag onto conveyor	2	.13	.01	.14
Place turkey in bag	4	.25	.03	.28
Close bag on vacuum machine and trim end of bag	4	[2] .28	0	.28
Total	13	.86	.05	.91

[1]Job-regulated wait-time.
[2]The labor requirement for this operation was 0.29 man-hour per 100 birds (see table 1). In this combination the workers are required to work at 2 percent above normal pace.

THE EXPERIMENTAL WEIGHING AND BAGGING SYSTEM

The experimental weighing and bagging system was designed to receive turkeys from the giblet-stuffing station and to deliver them to the vacuum and bag-sealing station in the same manner as a conventional line. The system consists of a scale with a magnified readout dial that is turned 90° from the normal position; a chute designed to guide turkeys into plastic bags; and a rack that holds three kinds of bags. The chute has side flaps and its bottom is shaped to fit the turkey back. Two pins projecting from the bottom of the chute hold the turkey in place while the bag is fitted over the chute. The pins are retracted by a knee-operated lever. Details of the equipment are given in the section, "Design of the Experimental Equipment." Three workers are required to weigh and bag the turkeys: a scale operator, a chute operator, and a worker who marks the weight of the turkeys on the bags.

The experimental weighing and bagging station is shown in figure 6. The scale operator stands at left in front of the scale platform and slides turkeys from the giblet-stuffing table (at left of scale platform) onto the scale (fig. 7). A second worker, standing behind the bag rack, reads the weight of the turkey, marks the weight on a bag, and holds the bag open for the chute operator. The scale operator slides the turkey into the chute. The chute operator, standing in front of the chute and rack, takes the bag from the bag marker, threads it onto the chute, and pushes the lever that releases the turkey

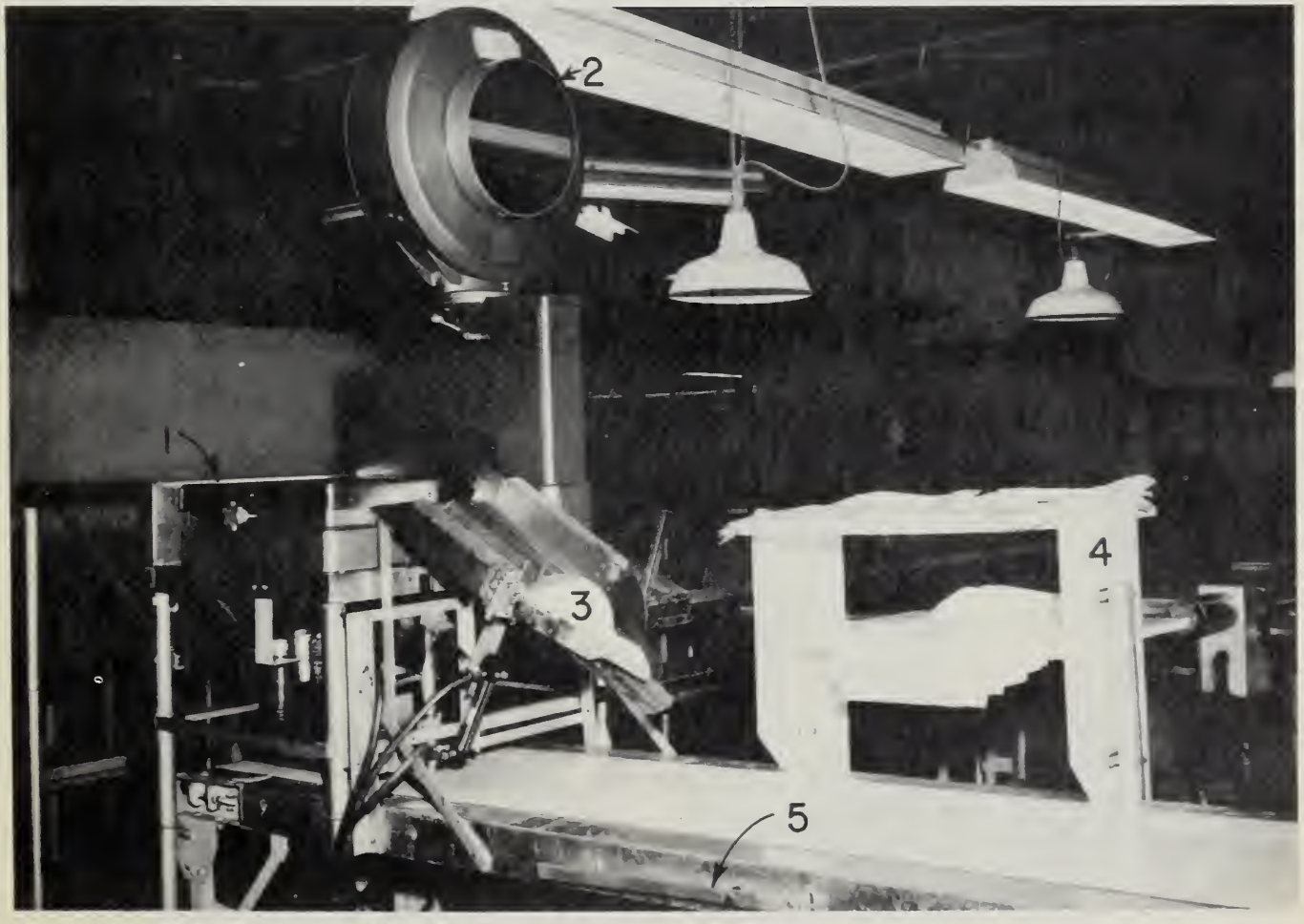

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Figure 6.--Experimental weighing and bagging station: (1) Scale platform; (2) scale dial; (3) chute; (4) bag rack for three types of bags; (5) knee-operated lever that releases turkey from chute. The conveyor below the chute leads to the vacuum and bag sealing station.

from the chute into the bag. The chute operator then drops the bagged turkey onto the conveyor.

Starting with a turkey in the chute (fig. 8) and a bag threaded onto the chute, the sequence of operations is as follows: The chute operator pushes the lever and the turkey slides into the bag. The chute operator then slides the turkey from the chute onto the conveyor and takes a new bag held open for him by the bag marker (fig. 9). As the turkey slides out of the chute, the scale operator slides a new turkey into the chute and the next turkey onto the scale (fig. 10). Concurrently, the bag marker reads the weight of the turkey on the scale, marks the weight on a bag, and with her left hand opens the bag for the chute operator (see fig. 8). After sliding the bagged turkey onto the conveyor, the chute operator grasps the next bag and repeats the cycle.

OPERATING TECHNIQUES

The time requirements for chute operation, scale and chute loading, and bag marking are closely related. The crew must be trained to gain maximum benefit from the equipment. The techniques worked out during operation of the experimental system in a commercial plant are described below.

Chute Operation

The worker operating the chute pivots his body slightly toward the bag rack and takes a bag. With the middle and index fingers of each hand inside the bag and his thumbs pressing against them from outside, he holds the bag at right angles to the chute and places it over the chute lip (figs. 11 and 12).

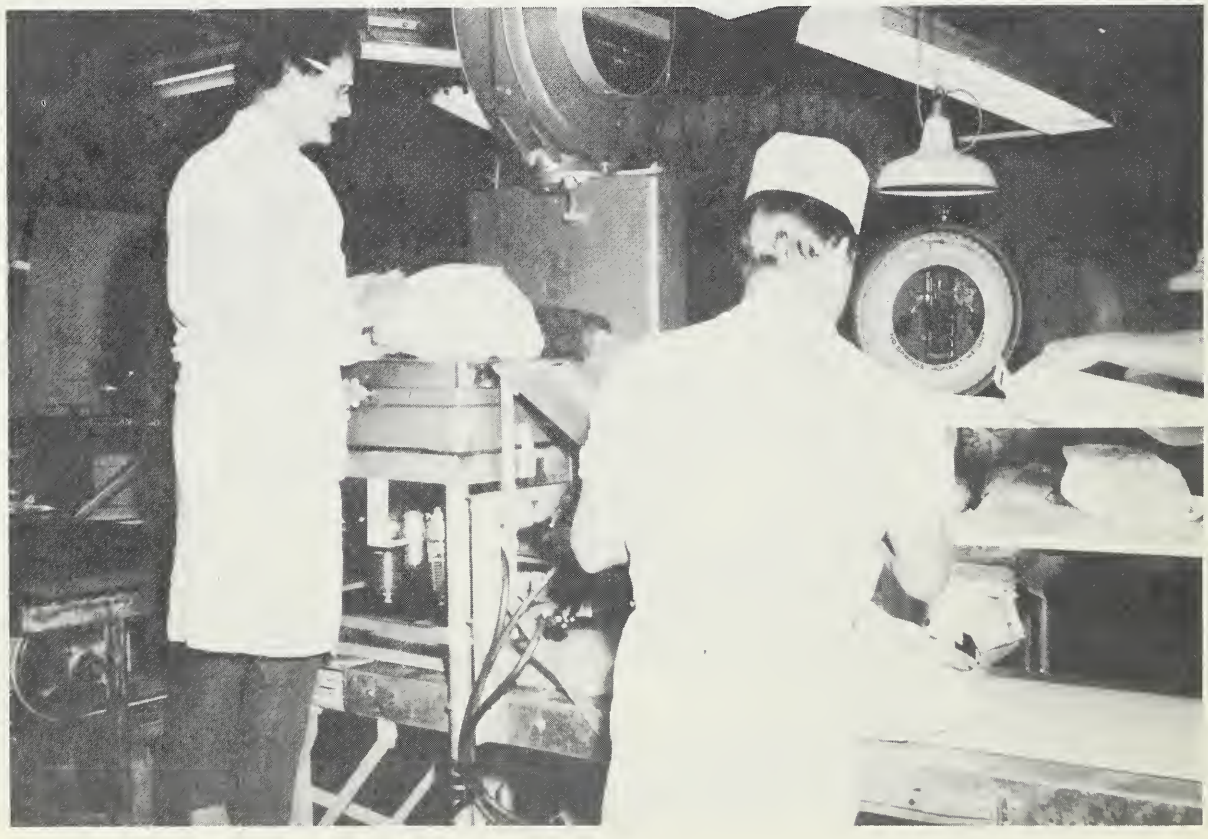

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Figure 7.--The experimental line during plant tests. The scale operator has placed a turkey on the scale and the chute operator has dropped a bagged turkey onto the conveyor. The hand and forearm of the bag marker, holding a bag open, are visible at right.

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Figure 8.--A turkey is in the chute and the chute operator is holding a bag in position at the end of the chute. In the background, the bag marker holds a bag open for the chute operator.

When the bag is properly positioned on the chute, the operator pushes the release lever with his knee and holds the bag while the turkey slides down the chute. He then drops the bagged turkey on the conveyor, and a new cycle begins.

A production rate of 746 birds per hour was attained for this operation. (See Appendix table 7. Table 7 also shows labor requirements for the elements involved in the operation.)

Scale and Chute Loading

The scale operator slides the first bird onto the scale platform, and from then on simultaneously pushes a bird from the scale into the chute and slides another bird onto the scale. Care must be taken in moving the bird into the chute so that its back rests in the shaped bottom of the chute. A production rate of 919 birds per hour was attained for this operation.

Bag Marking

The worker who marks bags reads the turkey's weight on the scale dial, selects the proper bag, and marks the weight on the bag. The worker then opens the bag with her left hand and holds it open until the chute operator grasps it. A production rate of 740 birds per hour was attained for this operation.

CREW ARRANGEMENTS AND LABOR REQUIREMENTS

Figures 13 and 14 illustrate the crew arrangements for the one- and two-scale systems, and tables 5 and 6 show production rates and labor requirements.

The labor requirements for the one-scale system are 0.84 man-hour per 100 birds and for the two-scale system, 0.77 man-hour per 100 birds.

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Figure 9.--The chute operator takes a new bag from the bag marker as a bagged turkey is dropped onto the belt conveyor.

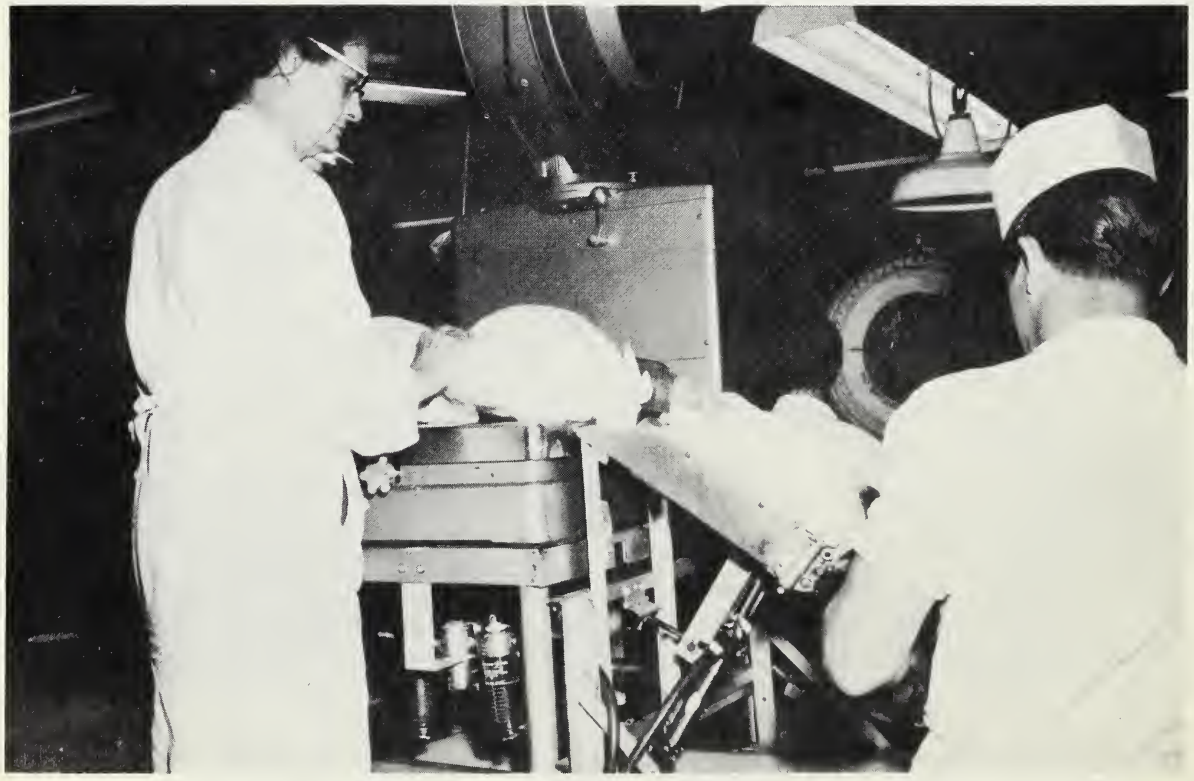

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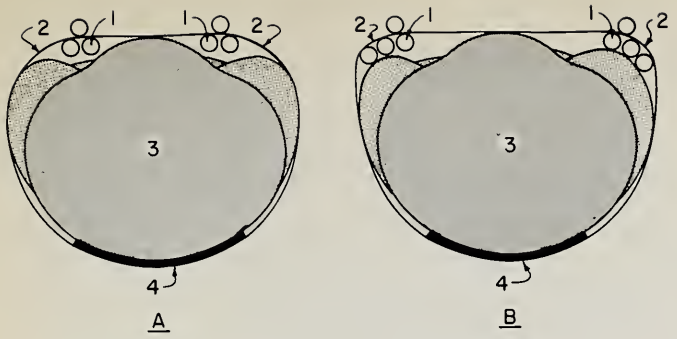
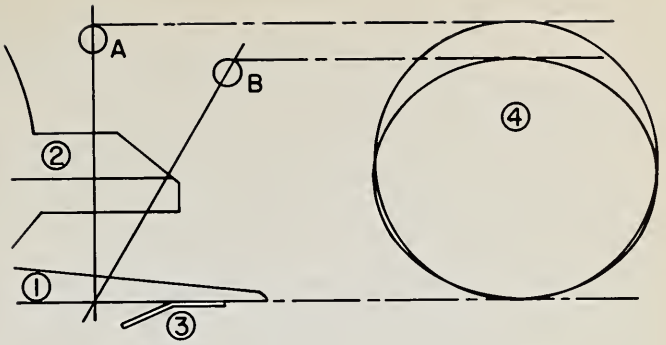
Figure 10.--The scale operator is ready to slide a weighed turkey into the chute and move another turkey onto the scale.



LEGEND

① — OPERATOR'S FINGERS
② — BAG
③ — TURKEY
④ — CHUTE

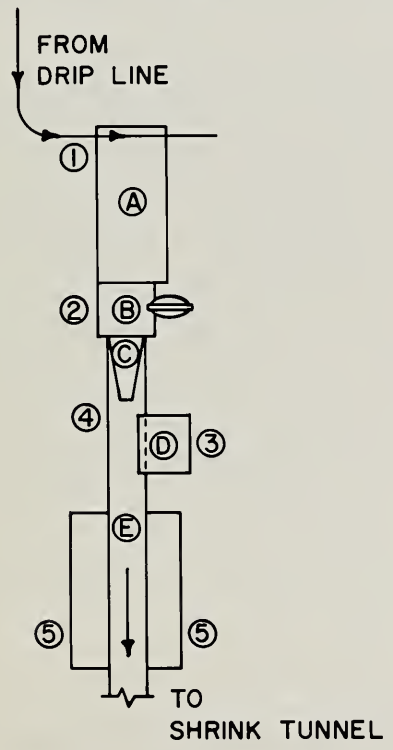
Figure 11.--A. When the bag is held so that the operator's fingers are in the recesses between the turkey's breast and legs, the minimum-size bag can be used. B. When the operator uses too many fingers to hold the bag, or places them near the edges of the chute, friction is created and it is difficult to place the turkey in a close-fitting bag.



LEGEND

① CHUTE BOTTOM
② CHUTE FLAP
③ CHUTE LIP
④ BAG OPENING
Ⓐ HAND POSITION WHEN BAG OPENING IS AT MAXIMUM SIZE
Ⓑ HAND POSITION REDUCING BAG OPENING

Figure 12.--The bag should be held at right angles to the chute to obtain the maximum bag opening.

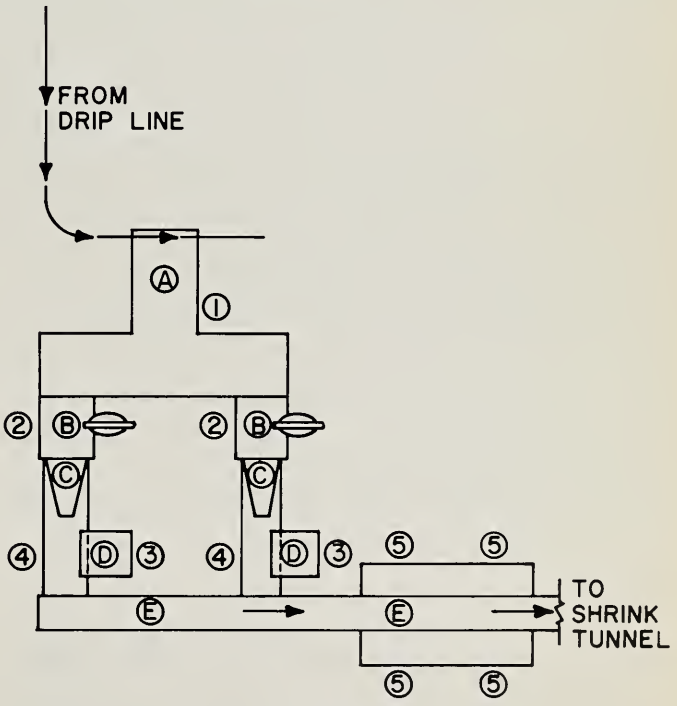


LEGEND

Ⓐ—RECEIVING TABLE
Ⓑ—SCALE
Ⓒ—CHUTE
Ⓓ—BAG RACK
Ⓔ—CONVEYOR

①—GIBLET STUFFER
②—SCALE & CHUTE LOADER
③—BAG MARKER
④—CHUTE OPERATOR
⑤—BAG CLOSER

Figure 13.--Crew and equipment arrangement for the experimental equipment using one scale.



LEGEND

Ⓐ RECEIVING TABLE
Ⓑ SCALE
Ⓒ CHUTE
Ⓓ BAG RACK
Ⓔ CONVEYOR

① GIBLET STUFFER
② SCALE & CHUTE LOADER
③ BAG MARKER
④ CHUTE OPERATOR
⑤ BAG CLOSER

Figure 14.--Crew and equipment arrangement for the experimental equipment using two scales.

TABLE 5.--Labor required to weigh and bag 100 hen turkeys on a one-scale line, using the experimental weighing and bagging system

[Elapsed time--0.14 hour; production rate--710 birds per hour]

Operation	Crew size	Labor requirements		
		Productive	Unproductive[1]	Total
	Number	Man-hours	Man-hours	Man-hours
Stuff giblets into turkey	1	0.06	0.08	0.14
Slide turkeys onto scale and off scale into chute	1	.11	.03	.14
Read weight, select bag, mark weight on bag, and hold bag open for chute operator	1	.14	0	.14
Obtain bag and place bag on chute, push lever releasing turkey into bag, and drop bagged turkey onto conveyor	1	.14	0	.14
Close bag on vacuum machine and trim end of bag	2	[2] .28	0	.28
Total	6	.73	.11	.84

[1]Job-regulated wait-time.
[2]The labor requirement for this operation was 0.29 man-hour per 100 birds (see table 1). In this combination the workers are required to work at 2 percent above normal pace.

TABLE 6.--Labor required to weigh and bag 100 hen turkeys on a two-scale line, using the experimental weighing and bagging system

[Elapsed time--0.07 hour; production rate--1,430 birds per hour]

Operation	Crew size	Labor requirements		
		Productive	Unproductive[1]	Total
	Number	Man-hours	Man-hours	Man-hours
Stuff giblets into turkey	1	0.06	0.01	0.07
Slide turkeys onto scale and off scale into chute	2	.11	.03	.14
Read weight, select bag, mark weight on bag, and hold bag open for chute operator	2	.14	0	.14
Obtain bag and place bag on chute, push lever releasing turkey into bag, and drop bagged turkey onto conveyor	2	.14	0	.14
Close bag on vacuum machine and trim end of bag	4	[2] .28	0	.28
Total	11	.73	.04	.77

[1]Job-regulated wait time.
[2]The labor requirement for this operation was 0.29 man-hour per 100 birds (see table 1). In this combination the workers are required to work at 2 percent above normal pace.

COMPARISON OF EXISTING AND EXPERIMENTAL SYSTEMS

In comparison with existing systems, the experimental system performs with lower manpower requirements for both the one- and two-scale arrangements. For an existing one-scale system, 90 man-hours per 10,000 birds are required to stuff giblets, weigh carcasses, mark bags, insert carcasses into bags, and close bags. The experimental system requires 84 man-hours, a reduction of 7 percent in the overall labor requirements. With a two-scale line, the best existing systems require 91 man-hours per 10,000 birds, while only 77 man-hours are required for the experimental system. This represents a 15-percent reduction in the overall labor requirements.

GENERAL RECOMMENDATIONS FOR INCREASED EFFICIENCY IN BAGGING AND WEIGHING OPERATIONS

Operating techniques and equipment that can contribute to efficient weighing and bagging operations, regardless of whether they are employed on existing equipment or on the experimental system, are as follows:

1. To reduce scale settling time, slide the carcass to be weighed onto the scale as the one just weighed is removed.
2. Use a quick-settling scale with large numerals on the dial.
3. Mount scales independently to reduce vibrations.
4. When using more than one scale, route predetermined sizes, grades, and brands to each scale to keep the number of bags (kinds and sizes) to be used at each scale to a minimum.
5. Balance the crew by adding or removing assignments for each worker so that the overall production rate is at a maximum level.
6. Use above-average workers on the more difficult or bottleneck operations.
7. Provide work-station arrangements that minimize long reaches and eliminate hand motion interference.

DESIGN OF THE EXPERIMENTAL EQUIPMENT

The design details of the components of the experimental weighing and bagging system are shown in the appendix (figs. 15, 16, 17). The chute and bag rack should be constructed of stainless steel with rounded corners and coved bends. Other parts of the unit coming in contact with product must also meet food handling requirements. The features which appear to be critical or might require additional modification are discussed below.

Special consideration was given to the problems of guiding the carcass into the bag so that proper orientation of the breast and the bag label could be effected; the smallest size bag could be used; the neck flap (skin) is maintained in its position; and entry of the bird into the chute is as smooth as possible. The chute bottom (fig. 16) was designed to fit the shape of the turkey back and to guide the carcass into the bag. The chute flaps were carefully shaped to hold the wings close to the body and to avoid entanglement on entry into the bag. The front part of the chute, the flaps, and the chute lip were all designed so as to minimize obstructions to the bird as it entered the bag.

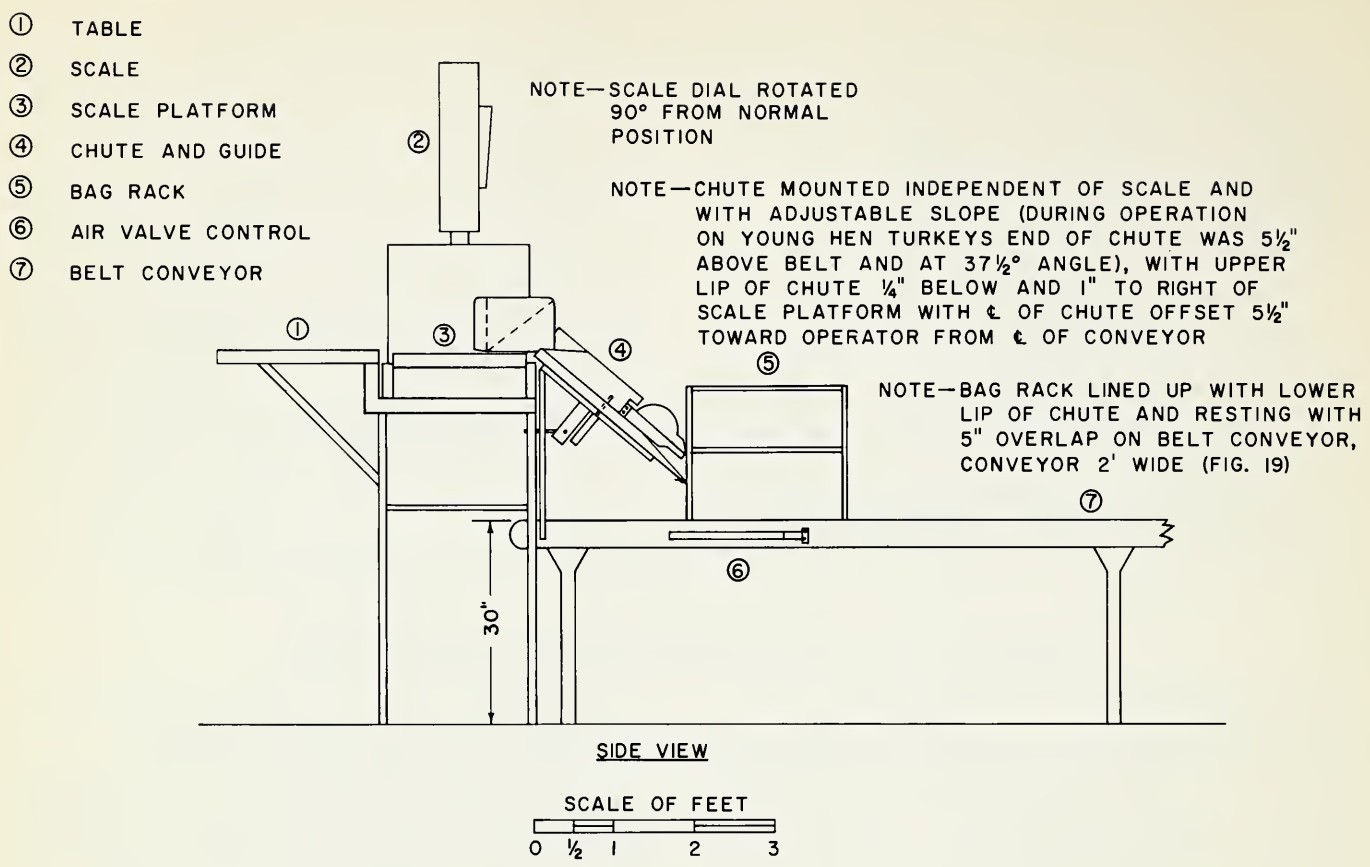
During the tests, 12-inch bags were used on hen turkey carcasses 11 pounds and under, and 13-inch bags were used on birds over 11 pounds. It was felt that with more training the operators would be able to use 12-inch bags for birds larger than 11 pounds.

The chute lip (see fig. 12) was designed to keep the bag from slipping off the bottom of the chute when the bird begins its entry. With the bag threaded onto the chute to a point about an inch above the lip, the bag expands to fit the chute shape and is held firmly in place, thereby increasing the range of turkey sizes that can be used for any one bag size.

The pins which are retracted to release the carcass are actuated by a 1-inch-bore air cylinder under pressures ranging from 20 to 40 pounds per square inch. Spacing these pins about 3 1/2 inches apart, rather than the 2 1/8-inch spacing used, might be a desirable refinement to provide more ease in alining the carcass with the chute. With the spacing used, only one shoulder of the carcass contacts one of the pins, causing the carcass to turn slightly in the chute.

The holding pins help position the neck skin, tending to draw it into place as the turkey slides into the bag.

The adjustable slope of the chute was required to accommodate birds of different sizes. Less chute slope is required for larger birds. For smooth operation, the spacing between the chute bottom and conveyor should



INTEGRATED BAGGING STATION

Figure 15

be such that when the bird ejects from the chute and reaches the bottom of the bag it has also made contact with the conveyor. Experience during the tests indicated that additional momentum of the carcass' sliding down the chute could be obtained by making the entire chute slightly longer, and locating the pins so that the carcass slides farther after release.

Toms over 23 pounds were not used in the tests because the chute was not wide enough. Slight modifications in the width and the contoured sections of the chute would be necessary to accommodate the larger turkeys.

The bag rack was designed to hold, conveniently, two kinds of bags on the top shelf and one on the bottom shelf. Several bag rack designs were considered in an effort to provide convenient work stations for both the bag marker and the chute operator. The shelves were staggered (fig. 17) to provide convenience in reaching the bags at different levels, and to permit the bag marker a view of the area on the bag upon which the weight is marked. During the last phases of the commercial testing it was noted that the shelf design, as shown, interferes with the worker's ability to open bags on the lower shelf. Slight modification of the rack design would be necessary to correct this condition; that is, supporting the shelf so that the bag marker's left hand can conveniently reach the front of the bag on the bottom shelf, and adding to the shelf length to provide more convenient positioning of the bags.

The scales must include dial magnification equipment to provide legibility. They should be the type that can be rotated 90° away

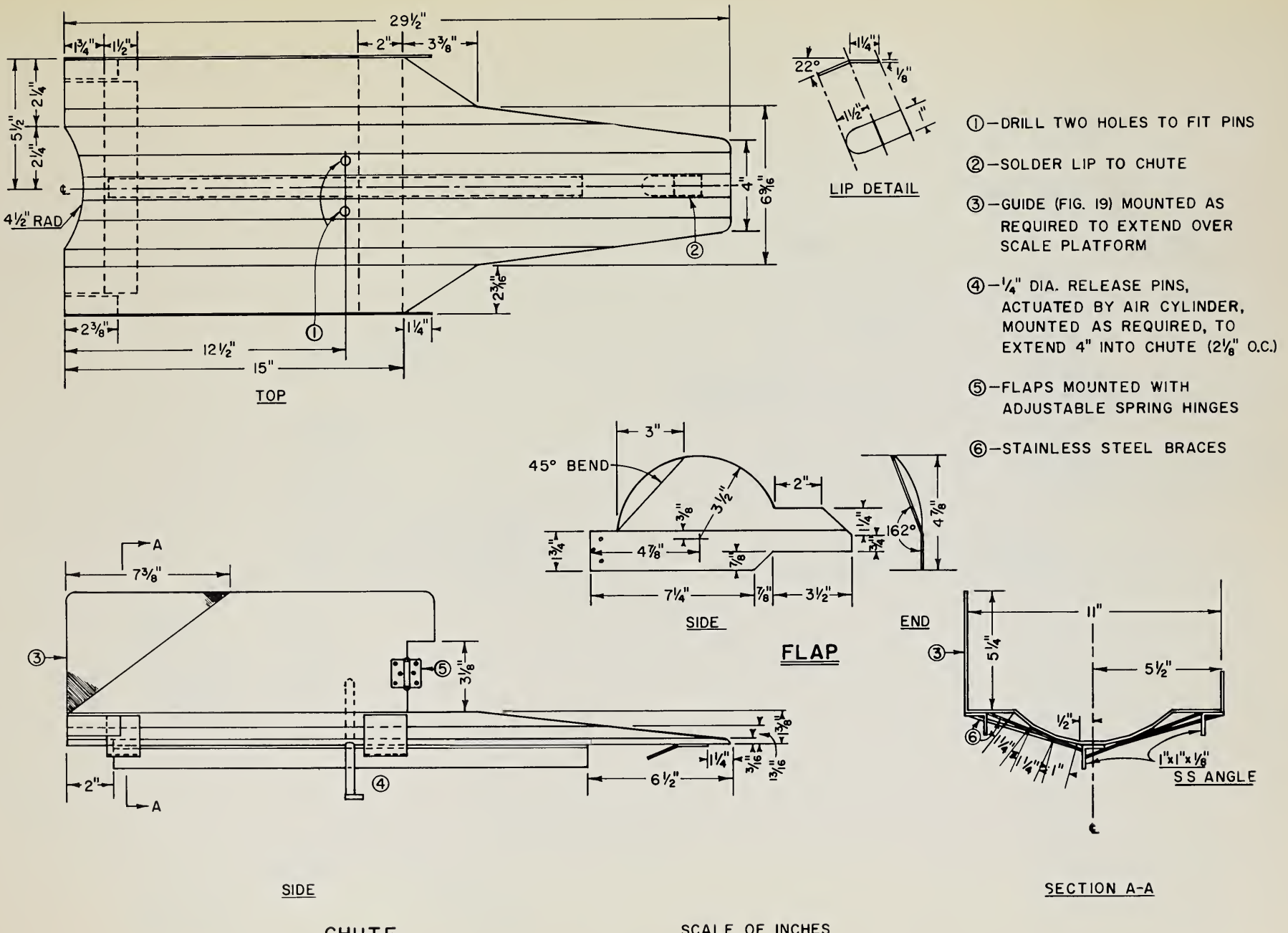
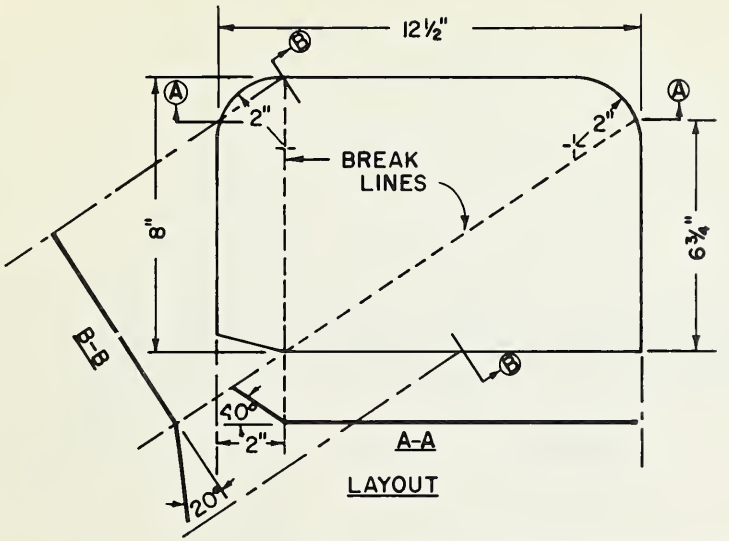

29½"
1¾"
1½"
2"
3⅜"
5½"
2¼"
2¼"
4½" RAD
4"
6⅜"
2⅜"
2³⁄₁₆"
2⅜"
12½"
15"
1¼"
①
②
TOP
22°
1¼"
⅛"
1½"
1"
LIP DETAIL
①—DRILL TWO HOLES TO FIT PINS
②—SOLDER LIP TO CHUTE
③—GUIDE (FIG. 19) MOUNTED AS REQUIRED TO EXTEND OVER SCALE PLATFORM
④—¼" DIA. RELEASE PINS, ACTUATED BY AIR CYLINDER, MOUNTED AS REQUIRED, TO EXTEND 4" INTO CHUTE (2⅛" O.C.)
⑤—FLAPS MOUNTED WITH ADJUSTABLE SPRING HINGES
⑥—STAINLESS STEEL BRACES
3"
45° BEND
2"
3½"
⅜"
1¼"
¾"
1¾"
4⅞"
⅞"
7¼"
⅞"
3½"
162°
4⅞"
SIDE
FLAP
END
A
7⅜"
③
⑤
3⅛"
2"
④
A
6½"
1¼"
3⁄16"
13⁄16"
1³⁄₁₆"
11"
5¼"
5½"
½"
⑥
1¼"
1¼"
1"
1"x1"x⅛"
SS ANGLE
SIDE
SECTION A-A
CHUTE
SCALE OF INCHES
0 1 2 3 4

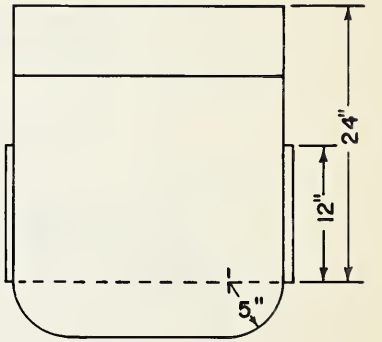
Figure 16



NOTE—18 GA. STAINLESS STEEL WITH BREAK ANGLES INDICATED BY SECTIONS A-A AND B-B. MOUNTED TO CHUTE SIDE AS REQUIRED.

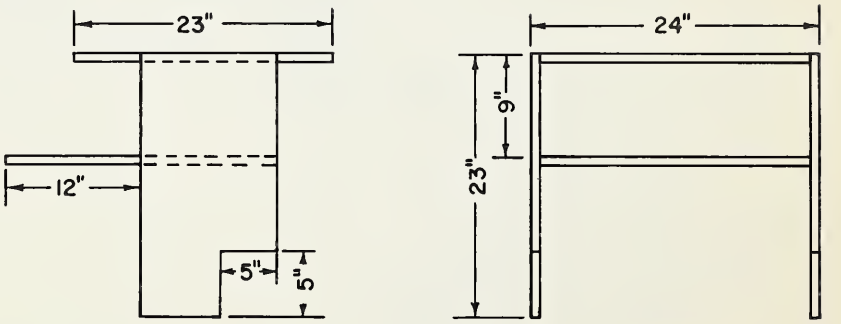
GUIDE

SCALE OF INCHES
0 1 2 3 4



TOP

NOTE—BOTTOM SHELF MOUNTED 10" ABOVE CONVEYOR.



SIDE FRONT

BAG RACK

SCALE OF INCHES
0 3 6 12

Figure 17

from the normal dial position (fig. 7), and be quick settling. Because of the height, above the floor, at which the scales are located, it is necessary that the supporting structure be equipped with a leveling-adjustment device. It is desirable that the scales be securely mounted and independent of other equipment to eliminate vibrations.

The conveyor should be 2 feet wide and 30 inches above the floor at the bagging station. It should be free from obstructions to the hand motion patterns of the chute operator, of sufficient length to convey the bagged birds to the bag-closing station and capable of a belt speed of at least 30 feet per minute.

The cost of a system employing the experimental chute on a new installation was not determined, but it should not be appreciably different from existing systems since the only items not now in use are the chute and a new style bag rack. Additional costs would be for increasing the elevation of the equipment and providing stands for workers.

APPENDIX

TABLE 7.--Labor requirements and production rates for weighing, marking bags, and bagging 100 hen turkeys with the experimental weighing and bagging system[1]

Operation	Element	Labor required[2]	Production rate
		Man-hours	Birds per hour
Operate Chute	Mount bag on chute	.0685	
	Release bird into bag	.0310	
	Obtain bag	.0362	
	Total	.1357	736
Load scale and chute	Slide bird onto scale and concurrently slide bird on scale into chute	.0666	
	Reposition hands for next cycle[3]	.0422	
	Total	.1088	919
Mark bag	Read scale	.0395	
	Mark and hold bag in position for chute operator to grasp[4]	.0957	
	Total	.1352	740

[1]Based on time studies with a crew having limited training.
[2]Time values obtained by motion picture techniques. Number of decimals indicates precision of measurement.
[3]Starting cycle involves load scale only.
[4]Hand and body positioning motions and bag opening are performed during the "read scale" element.

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